TITLE OF THE INVENTION

METHOD AND DEVICE FOR STACKING AN INCOMING SHEET STREAM

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CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority under 35 U.S.C. §119 of German Patent Application No. 103 07 785.5, filed on February 14, 2003, the disclosure of which is expressly incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The invention is concerned with a device for stacking an incoming sheet stream, in particular for stacking sheets made from paper, cardboard, film or the like, formed in, e.g., size cutters. The device includes a feed belt for the sheets to be stacked, a receiver to form a stack from the sheets, a separating element for separating the stack into a collected stack to be changed, on the one hand, and a pre-collected stack, on the other hand. A holding element is also provided for holding the pre-collected stack, which is formed from several elements arranged on a crossbeam. A separating table is utilized to receive the pre-collected stack during the stack change. A forward front stop and a rear detector are provided for guiding and/or aligning the stack.

2. Discussion of Background Information

[0003] Such devices serve, for example, in paper manufacture or in the production of formats from a material web wound on reels, for stacking the sheets formed in a size cutter. The sheets thus run in a sheet stream over a feed belt, which is also designated as a kicker belt, into the device for stacking and are collected there on a receiver – conventionally a pallet. At a forward stop, i.e., the front stop, the incoming sheets come to rest on the side of the stack facing away from the feed belt. A rear detector, which is arranged on the side of the stack facing the feed belt, serves to guide the sheets on the side opposite the front stop and for aligning the sheets. The pallet is lowered accordingly with increasing stack height. To initiate a stack change when the device is running or for continuously

incoming sheet stream, a so-called separating element, which is advantageously designed like a comb, is introduced into the stack of collected sheets at a defined position. The holding element, which provides the hole required for introducing the separating table, is introduced into this hole formed by the separating element. The separating table with a continuous table plate is then pushed completely into the hole, so that the stack is divided into a finally collected stack to be changed, which lies on the pallet, and a pre-collected stack, which lies on the separating table. The finally collected stack may then be removed below the separating table, so that a new, empty pallet may be positioned below the separating table. By withdrawing the separating table and the holding element, the pre-collected stack is deposited on the new empty pallet.

[0004] However, such devices have the disadvantage that the stack with the pre-collected sheets, that is the stack situated on the separating table, is as it were guide-less during changing – more precisely during withdrawal of the separating table – at least on the side of the stack facing the feed belt, since the detector only extends in the upper edge region of the stack. Hence, particularly during stacking of sheets or stack change of finished full stacks of sheets, for example made from paper, cardboard or the like, there is slipping of the pre-collected stack, particularly in the region of the side of the stack facing the feed belt.

SUMMARY OF THE INVENTION

[0005] The invention therefore provides for a device which guarantees safe guiding of the pre-collected stack, particularly during stack change.

[0006] The invention also provides for a device of the type mentioned in above wherein the detector comprises a guide element which can be moved vertically to a plane set by the separating table. Continuous guiding of the pre-collected stack – even during the stack change – is thus guaranteed. This occurs because the guide element is adapted variably to the continuously growing, pre-collected stack. By providing a so-called after-running or co-running guide, the invention achieves a particularly effective method.

[0007] The guide element is advantageously formed from several telescoping rails arranged at a distance from one another. Guiding is thus possible in a particularly simple and safe manner, since the telescoping rails are continuously adapted to the height of the stack.

[0008] In a preferred development of the invention, the telescoping rails can be moved out or moved in inevitably by moving the crossbeam vertically relative to the plane. Complete guiding of the pre-collected stack during the entire change process is ensured by this design. Guiding is always effected in the region of the stack which is particularly sensitive to slipping or displacement during changing of a stack.

[0009] The invention also provides for a device for stacking an incoming sheet stream wherein the device comprises a sheet conveying device that feeds sheets to be stacked, a receiver device adapted to support a stack of the sheets, a separating element for separating the stack into a collected stack and a pre-collected stack, whereby the collected stack can be removed before the pre-collected stack, and a holding device for holding the pre-collected stack. The holding device comprises a first crossbeam and a plurality of holding elements arranged on the first crossbeam. A separating table is adapted to receive the pre-collected stack during stack changing. A forward guiding device is adapted to at least one of guide the stack and align the stack. A rear guiding device is adapted to at least one of guide the stack and align the stack. The rear guiding device comprises a movable guide arrangement adapted to move vertically relative to a plane of the separating table.

[0010] The device may be adapted to stack sheets made from at least one of paper, cardboard, foil, a flexible material, and a rigid material. The device may be adapted to stack sheet received from a size cutter. The sheet conveying device may comprise a feed belt. The receiver device may comprise a pallet. The forward guiding device may comprise a forward front stop and the rear guiding device may comprise a rear detector. The plane of the separating table may comprise a planar surface of the separating table.

[0011] The movable guide arrangement may be adapted to move in a direction that is generally perpendicular the plane of the separating table. The movable guide arrangement may be adapted to move vertically up and down relative to the plane of the separating table. The movable guide arrangement may comprise a plurality of spaced apart telescoping members. The movable guide arrangement may comprise a plurality of spaced apart telescoping rails.

[0012] The movable guide arrangement may comprise a plurality of telescoping devices which can move in a linear direction. Each of the plurality of telescoping devices may comprise an axis and each of the plurality of telescoping devices may move along the axis. Each of the plurality of telescoping devices may comprise a plurality of elements which slide within each other and which move between an extended position and a retracted position.

[0013] The movable guide arrangement may comprise a plurality of devices which change in length between at least an extended position and at least a retracted position. The movable guide arrangement may comprise a plurality of devices which change in length between at least an expanded length position and at least a contracted length position.

[0014] The device may further comprise a second crossbeam arranged in a region of the sheet conveying device. The movable guide arrangement may comprise a plurality of length changing devices. Each of the plurality of length changing devices may comprise an end which is at least one of connected to and attached to the second crossbeam. Each of the plurality of length changing devices may comprise another end which is at least one of connected to and attached to the first crossbeam. Each of the plurality of length changing devices may comprise a telescoping device which can move in a linear direction. Each telescoping device may comprise a telescoping rail. Each telescoping device may comprise elements which moved in and out of each other in a vertical direction relative to the plane of the separating table. Each telescoping device may comprise elements which move in and out of each other in a vertical direction

relative to the plane of the separating table and which can move with movement of the first crossbeam. Each telescoping device may comprise elements which move in and out of each other upon movement of the first crossbeam. Each telescoping device may be attached firmly to the second crossbeam and is adapted to move with the first crossbeam. The first crossbeam may be adapted to move back and forth along a transport direction. The transport direction may be generally parallel to the plane of the separating table. Each telescoping device may be connected to the first crossbeam by a bolt and sleeve connection. Each telescoping device may be movably connected to the first crossbeam by a bolt and sleeve connection.

[0015] The first crossbeam may be adapted to move back and forth along a transport direction. The transport direction may be generally parallel to the plane of the separating table.

[0016] The movable guide arrangement may comprise members made of a material with high rigidity. The device may comprise a modular arrangement. The device may be arranged to form a module.

[0017] The invention also provides for a method of changing stacks of sheets using the device described above wherein the method comprises feeding the sheets onto the receiver device with the sheet conveying device, separating with the separating element the stack of sheets into a collected stack and a pre-collected stack, holding with the holding device the pre-collected stack, moving the separating table between the pre-collected stack and the collected stack, removing the collected stack and the receiver device, arranging another receiver device below the separating table, moving the separating table away from a position between the pre-collected stack and the other receiver device, moving the first crossbeam away from the pre-collected stack and in a direction that is generally parallel to the plane of the separating table, and supporting the pre-collected stack on the other receiver device.

[0018] The invention also provides for a method of continuously changing stacks of sheets using the device described above wherein the method comprises

feeding the sheets onto the receiver device with the sheet conveying device, separating, during the feeding, with the separating element the stack of sheets into a collected stack and a pre-collected stack, holding, during the feeding, with the holding device the pre-collected stack, moving, during the feeding, the separating table between the pre-collected stack and the collected stack, removing, during the feeding, the collected stack and the receiver device, arranging, during the feeding, another receiver device below the separating table, moving, during the feeding, the separating table away from a position between the pre-collected stack and the other receiver device, moving, during the feeding, the first crossbeam away from the pre-collected stack and in a direction that is generally parallel to the plane of the separating table, and supporting, during the feeding, the pre-collected stack on the other receiver device.

[0019] The invention also provides for a device for stacking an incoming sheet stream wherein the device comprises a sheet conveying device that feeds sheets to be stacked, a movable separating device comprising separating fingers that separate the sheets into a first upper stack and a second lower stack, whereby the second lower stack is removed before the first upper stack, a movable holding device comprising a first cross-member and a plurality of support elements arranged on the first cross-member, a movable separating device adapted to receive the first upper stack during stack changing, a forward guiding device adapted to guide stacking of the sheets, and a rear guiding device adapted guide stacking of the sheets. The rear guiding device comprises a plurality of movable guide devices which move up and down. The device is adapted to stack sheets made from at least one of paper, cardboard, foil, a flexible material, and a rigid material.

[0020] The movable holding device may further comprise suction shoe devices. The movable holding device may be movable up and down and towards and away from the stacked sheets. The movable separating device may be movable up and down and towards and away from the stacked sheets. The sheet conveying device

may comprise a feed belt. The forward guiding device may comprise a forward front stop and the rear guiding device may comprise a rear detector. The plurality of movable guide devices may comprise a plurality of spaced apart telescoping devices. The plurality of spaced apart telescoping devices may move in a linear direction.

[0021] The invention also provides for a method of changing stacks of sheets using the device described above wherein the method comprises feeding the sheets onto a first receiver device with the sheet conveying device, separating with the movable separating device the sheets into a first upper stack and a second lower stack, supporting with the movable holding device the first upper stack, moving the movable separating device between the first upper stack and the second lower stack, removing the second lower stack and the first receiver device, arranging a second receiver device below the movable separating device, moving the movable separating device away from a position between the first upper stack and the second receiver device, moving the first cross-member and the plurality of support elements away from the first upper stack and in a direction that is generally parallel to a planar surface of the movable separating device, and supporting the first upper stack on the second receiver device.

[0022] The invention also provides for a method of changing stacks of sheets using the device described above wherein the method comprises feeding the sheets onto a first receiver device with the sheet conveying device, separating, during the feeding, with the movable separating device the sheets into a first upper stack and a second lower stack, supporting, during the feeding, with the movable holding device the first upper stack, moving, during the feeding, the movable separating device between the first upper stack and the second lower stack, removing, during the feeding, the second lower stack and the first receiver device, arranging, during the feeding, a second receiver device below the movable separating device, moving, during the feeding, the movable separating device away from a position between the first upper stack and the second receiver device, moving, during the

feeding, the first cross-member and the plurality of support elements away from the first upper stack and in a direction that is generally parallel to a planar surface of the movable separating device, and supporting, during the feeding, the first upper stack on the second receiver device.

[0023] The invention also provides for a device for stacking an incoming sheet stream wherein the device comprises a sheet conveying device that feeds sheets to be stacked, a movable separating device comprising separating fingers that separate the sheets into a first upper stack and a second lower stack, whereby the second lower stack is removed before the first upper stack, a movable first cross-member and a plurality of support elements arranged on the first movable cross-member. The movable first cross-member and a plurality of support elements are movable towards and away from stacked sheets and up and down. A non-movable second cross-member is provided. A movable separating device is adapted to receive the first upper stack during stack changing. A forward guiding device is adapted to guide stacking of the sheets. A rear guiding device is adapted guide stacking of the sheets. The rear guiding device comprises a plurality of movable guide devices which move up and down. Each of the plurality of movable guide devices comprises one end connected to the first cross-member and another end connected to the second cross-member. The device is adapted to stack sheets made from at least one of paper, cardboard, foil, a flexible material, and a rigid material.

[0024] The device may further comprise a plurality of suction devices arranged on the first cross-member. The movable separating device may comprise a movable separating table which moves movable up and down and towards and away from the stacked sheets. The sheet conveying device may comprise a feed belt. The forward guiding device may comprise a forward front stop and wherein the rear guiding device comprises a rear detector.

[0025] The plurality of movable guide devices may comprise a plurality of spaced apart telescoping devices. The plurality of spaced apart telescoping devices may move in a linear direction.

[0026] The invention also provides for a method of changing stacks of sheets using the device described above wherein the method comprises feeding the sheets onto a first receiver device with the sheet conveying device, separating with the movable separating device the sheets into a first upper stack and a second lower stack, supporting with the movable first cross-member and the plurality of support elements the first upper stack, moving the movable separating device between the first upper stack and the second lower stack, removing the second lower stack and the first receiver device, arranging a second receiver device below the movable separating device, moving the movable separating device away from a position between the first upper stack and the second receiver device, moving the first cross-member and the plurality of support elements away from the first upper stack and in a direction that is generally parallel to a planar surface of the movable separating device, and supporting the first upper stack on the second receiver device.

[0027] The invention also provides for a method of changing stacks of sheets using the device wherein the method comprises feeding the sheets onto a first receiver device with the sheet conveying device, separating, during the feeding, with the movable separating device the sheets into a first upper stack and a second lower stack, supporting, during the feeding, with the movable first cross-member and the plurality of support elements the first upper stack the first upper stack, moving, during the feeding, the movable separating device between the first upper stack and the second lower stack, removing, during the feeding, the second lower stack and the first receiver device, arranging, during the feeding, a second receiver device below the movable separating device, moving, during the feeding, the movable separating device away from a position between the first upper stack and the second receiver device, moving, during the feeding, the first cross-member and

the plurality of support elements away from the first upper stack and in a direction that is generally parallel to a planar surface of the movable separating device, and supporting, during the feeding, the first upper stack on the second receiver device.

[0028] Other exemplary embodiments and advantages of the present invention may be ascertained by reviewing the present disclosure and the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The present invention is further described in the detailed description which follows, in reference to the noted plurality of drawings by way of non-limiting examples of exemplary embodiments of the present invention, in which like reference numerals represent similar parts throughout the several views of the drawings, and wherein:

Fig. 1 shows a perspective view of the device in a state immediately after introducing a change process of a collected stack with telescoping rails moved in;

Fig. 2 shows a side view of the device according to Figure 1;

Fig. 3 shows a perspective view of the device immediately before depositing the pre-collected stack on an empty pallet with telescoping rails moved out; and

Fig. 4 shows a side view of the device according to Figure 3.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0030] The particulars shown herein are by way of example and for purposes of illustrative discussion of the embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the present invention. In this regard, no attempt is made to show structural details of the present invention in more detail than is necessary for the fundamental understanding of the present invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the present invention may be embodied in practice.

[0031] The device shown in Figures 1 to 4 serves in particular for stacking sheet-like material and for changing a stack with a continuously incoming sheet stream.

[0032] The device 10 shown in Figure 1 shows essential parts of an automatic large format depot, which as a module is part of a large size cutter (not shown). The device 10 comprises essentially a feed or conveying belt 11 for supplying a sheet stream formed from sheets 14 to a receiver 12. The sheets 14 are collected on the receiver 12 to form a stack 13. A separating table 15 is used to receive a pre-collected stack 16. A forward front stop 17 and a rear detector 18 guide are used to hold or align the stack 13 or the pre-collected stack 16. A separating element 19 is utilized for separating the collected stack 13 into the stack 13 to be changed and the pre-collected stack 16 and/or for providing a spacing or hole 20 in the stack 13. A holding element 21 is utilized for holding the pre-collected stack 16 and for providing the spacing or hole 20. The holding element 21 includes a crossbeam 22 and suction shoes 23 arranged thereon. The suction shoes 23, however, may also be replaced by other conventional holding and/or support arrangements or devices.

[0033] The separating element 19 includes a support 24, on which several separating fingers 25 are arranged. The support 24 with the separating fingers 25 can be moved in a transport direction A of the sheet stream (see arrow A in Figs 1 and 3). This direction A is also the direction of the X coordinate shown in Fig. 3. The support 24 with the separating fingers 25 can also be moved in a direction vertically to the plane 26 (X/Z plane) set by the separating table 15, i.e., in the direction of the Y coordinate shown in Fig. 3. The same applies to the separating table 15, i.e., the table 15 can also move back and forth along direction A and up and down along direction Y. The table 15 is otherwise designed to be two-dimensional and closed. The front stop 17 is likewise designed to be moveable up and down in a direction vertically to the plane 26 (i.e., the Y direction), but in a region of the upper edge of the stack 13 or 16.

[0034] The crossbeam 22 extends generally transversely to the transport direction A of the sheet stream. Several suction shoes 23 are generally arranged at a distance (e.g., at substantially equal distances) from one another on the side of the crossbeam 22 facing the front stop 17. The crossbeam 22, like the separating element 19, can be moved back and forth in transport direction A (i.e., along the X direction) and up and down in vertical direction (i.e., along the Y direction). The suction shoes 23 have supports 27 which serve to support the pre-collected stack 16, and also act as an introduction aid. In a modification of the embodiment shown, the holding element 21 may include and/or be replaced by other conventional holding and guide elements.

[0035] The rear detector 18 includes several two-dimensional pressure plates 28 or the like. The pressure plates 28 can be moved back and forth in transport direction A (i.e., the X direction) in oscillating manner via actuating elements (not shown). In the Y direction, the pressure plates 28 extend only over a small range and/or area, i.e., starting from an upper edge 29 of the stack 16 and extending downwards a small amount. The sheets 14 just coming onto the stack 13 or 16 are advantageously aligned and guided by way of the pressure plates 28. The movement path of the pressure plates 28 in the X direction is advantageously approximately ± 2 mm.

[0036] A fixed crossbeam 30, which can be attached and/or fixed and/or non-movably and/or fixedly mounted to, e.g., the frame (not shown) of the device 10, is arranged in the region of the feed belt 11. A guide element 31 is arranged on and/or connected to the fixed crossbeam 30. The guide element 31 is designed to be moveable. Specifically, the guide element 31 is designed to move up and down such that it can be adjusted like a roller blind in the Y direction. In this regard, the guide element 31 includes several telescoping rails 32. These rails 32 are attached to the crossbeam 30 at one of their free ends. This attachment may be designed to be releasable. Alternatively, these upper ends of the rails 32 can be fixedly attached to the crossbeam 30. In the embodiment shown, a plurality of bars 33

serve to provide a stiff connection between telescoping rails 32 and crossbeam 30 (see Figs. 2 and 4). However, the invention also contemplates a device which uses alternative mechanisms to the telescoping rails 32. These can include other linearly moveable devices, devices which utilize roller elements, withdrawable elements, or the like, etc. Preferably, such devices function in the manner of a guide element.

[0037] The telescoping rails 32 are arranged and/or spaced (e.g., equally spaced from one another) at a distance from one another, and specifically in the intervals or gaps between the individual pressure plates 28 of the detector 18. These rails 32 are formed from several elements which can be displaced and/or moved into one another. That is, the individual elements of each rail 32 are mounted to slide in and/or within one another via slide guides, ball guides or other conventional bearings. In this way, the individual elements can move linearly in and out of each other in a longitudinal direction. The other free end of the telescoping rails 32 are attached to the crossbeam 22. In this regard, each lowest and/or inner individual element of the rails 32 is connected to the crossbeam 22. This connection can be formed, for example, by a bolt 34 and a corresponding sleeve 35. This connection arrangement can also be formed by other conventional guide and/or slide elements provided they are designed such that the crossbeam 22, with the suction shoes 23 arranged thereon, can be moved in the X direction, whereas the telescoping rails 32 do not follow this movement but are fixed in the X direction. Each lowest element of each telescoping rail 32 may also be attached to an additional crossbeam (not shown). This would, in particular, improve stability. Each lowest element of the telescoping rails 32 is also preferably attached releasably to supporting plates by screwing or the like. The supporting plates can project essentially horizontally from the lowest elements of the telescoping rails 32 in the direction of the additional crossbeam, to which they are preferably releasably attached. The additional crossbeam can run essentially parallel to the crossbeam 22 and can be arranged at a distance from the latter in transport

direction A of the sheet stream in front of the crossbeam 22. The additional crossbeam can be fixed in the X direction and can be moved up and down in the Y direction, preferably synchronously with the crossbeam 22. The supporting plates can thus project into the region of the suction shoes 23, namely in particular into the gaps between the suction shoes 23. This additional attachment can lead to the telescoping rails 32 being firmly connected in each case to the uppermost element (by the crossbeam 30) and to the lowest element (by the additional crossbeam), so that the forces occurring due to the up and down movement and the stack to be guided, may be absorbed safely.

[0038] During the movement in the Y direction, the telescoping rails 32 inevitably follow the up and down movement of the crossbeam 22. Figure 1 shows a starting position and/or situation, wherein the telescoping rails 32 are moved up (i.e., all of the individual elements have moved linearly and completely into each other) so that they have only the length of a single element. During the downward movement of the crossbeam 22 (see Fig. 3) from the position shown in Figs. 1 and 2, the crossbeam 22 also draws the telescoping rails 32 downwards. The rails 32 also guide the downward movement of the crossbeam 22.

[0039] The telescoping rails 32 (or other similar guide elements) are preferably made from a high-strength material such as, e.g., a stiff high-strength material. They can also be mounted in simple manner in order to facilitate a retrofitting of existing devices 10 with the inventive arrangement. Overall the device 10 can be designed as a module, so that this module may be exchanged or retrofitted into existing or new devices in a simple manner.

[0040] A stack changing process which utilizes the inventive device will now be described. Starting from a state shown in Fig. 1, the collected stack 13 lies on the receiver 12 (which may be a conventional pallet). When the machine is running, a continuous supply of sheets 14 is fed from the size cutter to the stack 13. As soon as the stack 13 has reached a defined height, the separating element 19, with its separating fingers 25, moves into the stack 13 and thus forms a spacing or hole 20.

Additional incoming sheets 14 are stacked further over the stack 13. However, these additional sheets 14 rest instead on the separating fingers 25. The receiver 12 is lowered continuously downwards in the Y direction during the stacking. The separating element 19 follows this downward movement. The stack 13, moreover, is guided on one of its opposite sides by the front stop 17. On the opposite side, the stack 13 is guided, at least in one region of the upper edge 29, by the detector 18, and more specifically, the pressure plates 28 of the detector 18. The pressure plates 28 act to additionally ensure alignment of the newly incoming sheets 14 due to their oscillating movement. During the further downward movement of the stack 13, the uppermost element of the telescoping rails 32 also assumes a guiding function as part of the detector 18.

[0041] The holding element 21 is then pushed and/or positioned into the spacing or hole 20 provided and/or created by the separating element 19, and more specifically, created by the suction shoes 23. The entire stack is thus separated by the spacing or hole 20 into a collected stack 13, which is situated below the holding element 21 and which can then be removed, and a pre-collected stack 16. As soon as the holding element 21 is introduced, the continuous two-dimensional separating table 15 is pushed and/or moved into the spacing or hole 20, so that the stack 16 rests on the separating table 15. The stack 13 which is situated on the receiver 12 below the separating table 15 may now be removed from the device 10. A new empty receiver 12 may then be guided below the separating table (see Fig. 4). During this stack changing process, the sheets 14, which are stacked on the pre-collected stack 16, are added to the stack continuously. The pre-collected stack 16 is thus lowered continuously downwards in Y direction by the separating table 15 in order to always keep constant the feed height for the sheets 14. The crossbeam 22 is similarly also lowered together with the separating table 15 (see Fig. 3). The crossbeam 22 thus also draws the telescoping rails 32 downwards and/or leads to their moving out to an extended position. In this way, the pre-collected stack 16 is guided not only at its front side by the front stop 17 but also

its rear opposite side by the guide element 31 during the whole time of the stack changing process. Particularly during withdrawal of the separating table 15, guiding of the pre-collected stack 16 is maintained on both sides of the stack, so that the stack 16 is properly deposited on the new receiver 12. In this way, the new receiver 12 and stack 16 then becomes the stack 13 in the next cycle and retains its ideal "ice block form". After the holding element 21 has also been removed from the stack 13 or 16, the change cycle may be started anew.

[0042] It is noted that the foregoing examples have been provided merely for the purpose of explanation and are in no way to be construed as limiting of the present invention. While the present invention has been described with reference to an exemplary embodiment, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitation. Changes may be made, within the purview of the appended claims, as presently stated and as amended, without departing from the scope and spirit of the present invention in its aspects. Although the present invention has been described herein with reference to particular means, materials and embodiments, the present invention is not intended to be limited to the particulars disclosed herein; rather, the present invention extends to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims.